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Early Stages of *Speyeria nokomis* (Nymphalidae)

James A. Scott and
Sterling O. Mattoon

60 Estes Street, Lakewood, Colorado 80226 and
2109 Holly Avenue, Chico, California 95926

Abstract. The egg, larval stages, pupa, and developmental period of *S. nokomis* from the United States and Mexico are described and illustrated.

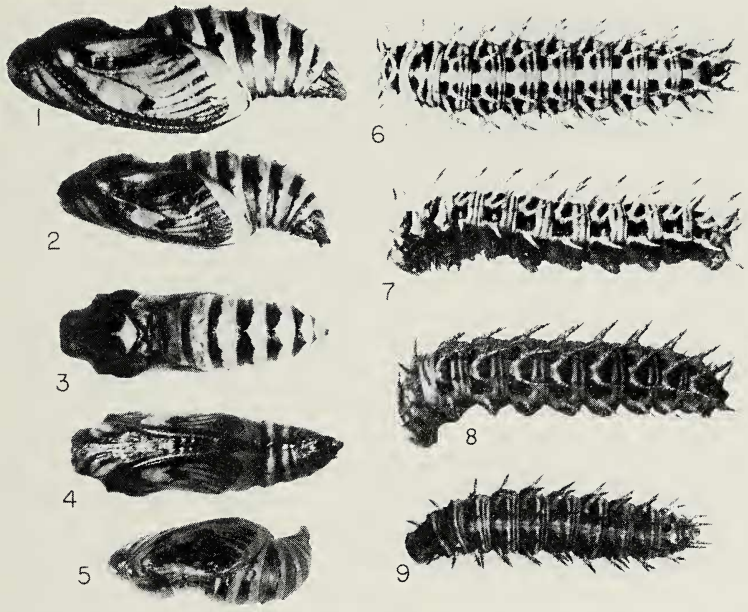
Introduction

Comstock (1928, 1940) and Skinner (1907) briefly described the egg, and young larva of *nokomis*, but not older larvae or pupae. This paper describes and illustrates the egg, larval, and pupal stages.

Early stages are based on several hundred eggs, larvae, and pupae reared from eggs laid by females from Elko County, Nevada (*S. n. apacheana* (Skinner)), Taos and San Juan Counties, New Mexico, the White Mountains of Arizona (*S. n. nokomis* (Edwards)), and Durango and Chihuahua states Mexico (*S. n. coerulescens* (Holland)). About 100 larvae were preserved from San Juan County, New Mexico (in J. Scott coll.), 10 or less from each of the other sites (in S. Mattoon coll.). Larvae were reared on *Viola*, including *V. nephrophylla*.

Early Stages Description

Egg: Cream colored when laid, becoming tan after a few days. Strongly ribbed vertically, with ribs rising to several peaks surrounding the micropyle (Fig. 11). Numerous horizontal crossbars connect the vertical ribs. Incubation period is about ten days in the lab at about 20°C and constant light. **Larva**, Figs. 6-11: There are six instars. Head capsule widths average approximately 0.35, 0.6, 1.0, 1.4, 2.4 and 3.5 mm for the six instars, an average of 60% growth at each moult, based on measurements of about 50 New Mexico head capsules. The head capsule has a dark area after the first instar (Fig. 11); the dark area is black in later instars. Instars 1 and 2 are cream-colored mottled with brown, with a light dorsal band and a light lateral band running through the spiracles. Brown mottling occurs elsewhere especially on intersegmental membranes. Body darker around sclerotized areas. First instar brown mottling of *S. n. coerulescens* is very similar to that of ssp. *nokomis*. Setal pattern of all instars appears identical in these two ssp. (Fig. 10). Instars 3 and 4 are orangish cream (head pale orangish brown), with black spots and lines like instars 5 and 6, except



Figs. 1-5. Pupae. Figs. 6-9. Mature larvae. Figs. 1-4, 6-7, Chihuahua State, Mexico. Fig. 8, Taos County, New Mexico. Figs. 5, 9-11, San Juan County, New Mexico.

middorsal pale band whitish in color in instars 3-4. Mature (5-6) larva orangish ochre (head pale reddish brown) with black spots and lines (Figs. 6-9); middorsal pale band also orangish ochre. Mature larva has a light dorsal band on abdomen, a lateral light band just ventral to spiracles. Scoli brown in color with black tips, although dorsal side of two lateral rows of scoli cream in color, subdorsal scoli cream on prothorax and 9th abdominal segment scoli dark brown. Dark brown patches occur around scoli. Two transverse black bands occur behind scoli on dorsum of most segments.

A difference was noted between populations in the color pattern of later instar larvae. Instars 3-6 of ssp. *nokomis* (from New Mexico and Arizona), and *apacheana* have ground color orangish ochre, whereas ground color of *coerulescens* larvae is light yellow.

Pupa: Pupa orangish ochre with black markings (Figs. 1-5). The extent of black varies especially on the wing cases. Pupae of ssp. *nokomis* are fairly dark, with wing cases mostly black (Fig. 5). Pupae of White Mountains, Arizona *nokomis*, and *apacheana*, are lighter, with lighter wing cases. Pupae of *coerulescens* (Fig. 1) are still lighter, with predominantly light wing cases (although some individuals are dark, Fig. 2) and the abdomen is somewhat lighter also.

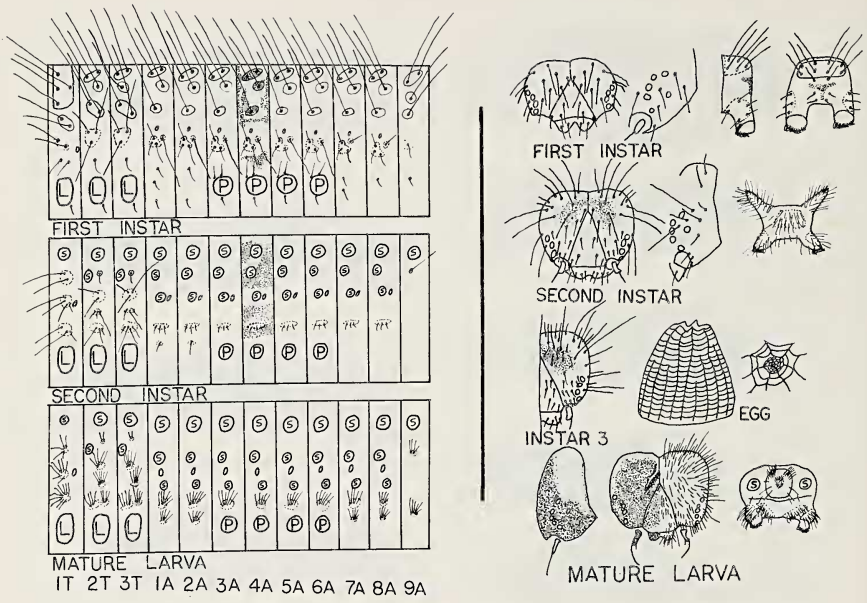


Fig. 10. Setal maps of larvae. Solid lines surround legs (L), prolegs (P), scoli (S), or sclerotized areas. Dash lines surround less well sclerotized areas. Small ovals on 1T (T = thorax) and 1-8A (A = abdomen) are spiracles. Stippling on first and second instar shows dark pattern of a typical segment.

Fig. 11. Head capsules of first, second, third, and mature larva, including view of left side of first, second, mature larva; terminal segments of first (lateral and posterior view), second, and mature larva; and egg (side view and dorsal view of micropyle). Stippling indicates dark areas; setae and color pattern of mature larva head is drawn on opposite sides of the head capsule.

Developmental Period and Male-Female Emergence Lag

Developmental period from oviposition to emergence of adults is 61 days for males, 69 days for females, indoors at about 20°C for ssp. *nokomis*, a difference of 8 days. However, the lab is much warmer on average than nature, so development is probably longer in nature. Because first stage larvae overwinter and adults fly mainly from late July to September, it is reasonable to estimate a 4 month developmental period in nature for females. With a 4 month or 122 day developmental time, the 8 days increases to a 14 day difference between male and female emergence in nature (8/69 = 14/122). Males precede females in emergence in most insects. *S. nokomis* males may appear in late July or early in August, but females normally appear much later in mid or late August. Scott (1977)

demonstrated mathematically that male butterflies (and most invertebrates) should precede females in emergence; he showed that females should emerge when males are most abundant (which is later than when most males emerge) in order to maximize the number of matings for males and minimize the time required for females to find a mate. This is the evolutionary explanation for males preceding females in emergence. The lag is implemented physiologically by the longer developmental time for females just noted. Scott (1977) noted that the most important factors influencing the optimum length of the lag in emergence are lifespan of males and standard deviation (spread) of emergence time of males, and that the lag should be small only if females mate often. A reviewer suggests that emergence lags occur because "females are larger than males necessitating a longer feeding period. Also, females must accumulate the proteins and lipids that will be used for egg production." Actually, the large size of females is a consequence of their longer feeding period, not vice versa. Also, Ronald Rutowski (pers. comm.) found that in *Pieris protodice* Bd. & LeC., larger males produce larger spermatophores (which are digested by females and used for producing eggs) and females prefer to mate with larger males. So, according to these findings there are quite valid reasons why males should feed longer to grow to large size (they mate more often when larger and their mates produce more eggs). Furthermore, it is not clear that females should be larger, because a small female would use less energy in flight so would have more energy available for producing eggs, and a given size of female could produce more offspring merely by producing smaller eggs. Plus, larger males might fly farther and mate with more females, and the larger spermatophores produced by larger males stretch the female's bursa copulatrix more and are digested slower so the female will remate later. Of course, thousands of species of Lycaenidae exist very well with small sized females. The essential point of this discussion is that there are clear and obvious reasons why males precede females in emergence, which have been independently verified by Wiklund and Fagerstrom (1977), whereas it is not at all clear whether females should be smaller or larger than males.

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